

# PATENT SPECIFICATION

1,022,574

DRAWINGS ATTACHED.

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## COMPLETE SPECIFICATION.

### Improvements in or relating to Breathing Apparatus Employing Two Sources of Breathable Gas.

We, NORMALAIR LIMITED, of West Hendford, Yeovil, in the County of Somerset, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in demand type breathing apparatus having a breathable gas pressure source from, for example a remote point by way of a pipe, and also a second gas pressure source from, for example self-contained supply.

A breathing apparatus having a remote supply and a supply carried by the user in the form of high pressure air cylinders is already well known in the art and one method employed to change over from the remote supply to the cylinder supply is to provide a pressure reducer on the outlet from a pair of cylinders, one of which is held in reserve by having its stop cock closed. The arrangement is such that the remote supply pipe joins the apparatus at a point between the demand regulator and the outlet of the pressure reducer. In operation such an arrangement is satisfactory in that the supply of breathable gas to the demand regulator is ensured should the remote supply fail, but it has several disadvantages. One being that there is no warning given to the user that the remote supply has failed, and he is using the cylinder supply and because of this a second reserve cylinder has to be carried.

Another disadvantage encountered with the above apparatus is that a pressure reducer has to be used, with added complications and increased costs.

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A further disadvantage encountered with the above apparatus is that two compressed air cylinders are carried and the apparatus is therefore far more bulky than with the arrangement now proposed.

It is an object of the present invention to provide an improved breathing apparatus having a remote supply of breathable gas and a self-contained supply wherein only one cylinder of breathable gas is required.

It is another object of the present invention to provide a breathing apparatus of the type described in the preceding paragraph wherein a warning in the form of a change in breathing characteristic is given to the user upon the failure of the remote supply.

It is a further object of the present invention to provide a breathing apparatus of the above type wherein a pressure reducing valve is not required.

According to the present invention we provide a demand type breathing apparatus having first and second pressure sources of breathable gas, said sources being ducted each to an associated demand valve, a differential pressure responsive diaphragm for automatically actuating the said demand valves, the first pressure demand valve being arranged to be maintained in the inoperative position out of contact with said diaphragm by gas bled from the second pressure source of supply, said gas bleed being effective upon pressure sensitive actuating means which provides displacement of said first pressure demand valve relative to the valve-contacting part of said diaphragm, as long as the pressure of said gas bleed remains above a predetermined value.

A preferred embodiment of the invention as applied to the breathing apparatus of a

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diver will now be described, by way of example only, with reference to the accompanying diagrammatic drawing.

The diver is provided with a suitable mouthpiece or full face mask which is connected by a conduit to the outlet 1 of a demand regulator shown generally at 2. Within the regulator 2 a differential pressure responsive diaphragm 3 is arranged such that one side is subjected to ambient pressure and the other side to the pressure at the outlet 1. Across the centre of the diaphragm 3 on the side facing the outlet 1 a short length of ramp 4 is mounted to act on the tilt valve lever.

A low pressure tilt valve 5 having a stem 6 is positioned in the body of the demand regulator 2 such that the stem 6 contacts the crest of the ramp 4. The tilt valve 5 is supplied with breathable gas from a low pressure supply 7 at, for example, a pressure of 100 p.s.i.; this supply is conveyed to the diver via a flexible pipe from a source at the surface. A high pressure tilt valve 8 having a stem 9 is also provided and the seating for the valve 8 is formed in the end of a hollow piston rod 10 which passes through the end wall of a cylinder 11, and is suitably sealed in the bore. A piston 12 having a peripheral seal is adapted to slide within the cylinder 11, and the piston 12 is either formed integrally with or connected to the piston rod 10. One end of a compression spring 13 acts upon the side of the piston 12 remote from the valve 8, the other end of the spring reacts against the body of the demand regulator. The hollow interior of the piston rod 10 is provided with a high pressure breathable gas supply 14 at, for example, a pressure of 3,000 p.s.i. from a source carried by the diver such as a single high pressure cylinder. A passage-way 15 communicates between the inside of the cylinder 11 and the low pressure supply 7 such that the side of the piston 12 remote from the compression spring 13 is always subjected to the pressure acting on the low pressure tilt valve 7.

In operation the diver's respiratory demands are met by gas from the low pressure tilt valve 5, which opens when a depression is created at the outlet 1, the diaphragm 3 causing the ramp 4 to deflect the stem 6. The requirements of the diver are fully met from the low pressure surface supply 7 as long as the pressure remains, for example, above 80 p.s.i. since the pressure acting on the piston 12 overcomes the force of the compression spring 13 and the high pressure tilt valve stem 9 is held as shown in its withdrawn position where it does not contact the ramp 4. If the low pressure surface supply 7 failed for any reason such that the pressure falls to below 80 p.s.i. the spring 13 will cause the high pressure

tilt valve stem 9 to advance into its operative position in contact with the ramp 4. The high pressure tilt valve 8 will then supply the respiratory demand of the diver from the high pressure cylinder supply source.

By suitably arranging the length of stem 9 and the diameter of the valve 8 a breathing characteristic can be chosen such that when the change over from the surface supply 7 to the cylinder supply 14 automatically occurs, the diver is immediately made aware of the changeover by the change in breathing characteristic.

It will be appreciated that although the diagrammatic drawing shows the stems 6 and 9 in the same plane, in practice these would be slightly staggered, such that they would be in side by side relationship when contacting the ramp 4.

In the preceding embodiment, the high pressure tilt valve 8 is moved axially, but it is to be understood that the invention is not limited to this constructional arrangement. For example, the valve seating for the high pressure tilt valve may be arranged to pivot about a point in the demand regulator body, a spring being provided to hold the seating in a first position in which the valve is in the operative position where the stem is in contact with the diaphragm, and a pressure responsive device such as a bellows having its interior connected to the low pressure supply being arranged to overcome in normal conditions the force of the spring and hold the seating in a second position where the tilt valve stem is in an inoperative position away from the diaphragm, so long as the low pressure supply is above a predetermined minimum.

Whilst the embodiments of the invention have been described with reference to a diver it is to be understood that the invention is not limited to underwater use. Apparatus according to this invention may be employed by personnel working in, for example, empty fuel tanks etc., the supply hose providing the low pressure supply 7 passing into the tank from an outside source, such as the factory air line supply. The working time is unlimited if an unlimited low pressure supply is available. If the low pressure supply line is severed or crushed, the high pressure tilt valve 8 automatically comes into use, and then the user has a limited amount of time in which to make the job on which he was working safe before he vacates the tank.

With breathing apparatus according to the present invention the need for a second reserve cylinder is removed and the bulk of equipment carried by the user is reduced.

The pressure reducer as used in the prior art apparatus has been eliminated in the

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breathing apparatus according to the present invention.

WHAT WE CLAIM IS:—

1. A demand type breathing apparatus  
5 having first and second pressure sources of  
breathable gas, said sources being ducted  
each to an associated demand valve, a differential  
pressure responsive diaphragm for  
10 automatically actuating the said demand  
valves, the first pressure demand valve being  
arranged to be maintained in the inoperative  
position out of contact with said diaphragm  
by gas bled from a second pressure source  
15 of supply, said gas bleed being effective  
upon pressure sensitive actuating means  
which provides displacement of said first  
pressure demand valve relative to the valve-  
contacting part of said diaphragm, as long  
20 as the pressure of said gas bleed remains  
above a predetermined value.  
2. A demand type breathing apparatus

as claimed in Claim 1, wherein the first  
pressure source is of higher pressure than  
the second pressure source.

3. A demand type breathing apparatus 25  
as claimed in Claim 1, or Claim 2, wherein  
each demand valve comprises a tilt valve  
having an internally protruding stem acted  
upon by the differential pressure responsive  
30 diaphragm.

4. A demand type breathing apparatus  
as claimed in Claim 1, Claim 2 or Claim 3,  
wherein in said pressure sensitive actuating  
means a spring provides an opposing force  
to the pressure obtained from the gas bleed. 35

5. A demand type breathing apparatus  
substantially as shown and described with  
reference to the accompanying diagrammatic  
drawing.

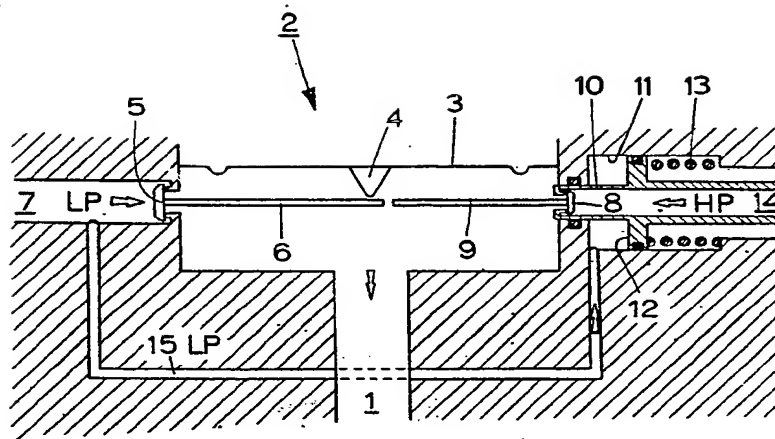
For the Applicants,  
L. H. HAYWARD.

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1 SHEET *This drawing is a reproduction of  
the Original on a reduced scale*



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